

Phsl lec 6

- **Renal blood flow and Oxygen consumption:**

90 % of RBF goes to the renal cortex,
9% goes to outer medulla and
1% to the inner medulla

- **RBF REGULATION OF RENAL BLOOD FLOW (Q)**

is *directly proportional* to the pressure gradient (ΔP) between the renal artery and the renal vein

Is *inversely proportional* to the resistance(R) of the renal vasculature

The major mechanism of changing Renal blood flow is by changing Afferent or Efferent Arteriolar resistance.

(* R= diluted or concentrated)

$$(Q) = \frac{\Delta P}{R}$$

Vasoconstrictors	Vasodilators
Sympathetic nerves (catecholamines)	PGE ₂
Angiotensin II	PGI ₂
Endothelin	Nitric oxide
	Bradykinin
	Dopamine

The endothelium of artery secretes:

Endothelin (VC)

NO (VD)

- **SYMPATHETIC NERVES AND CIRCULATING CATECHOLAMINES:**

Both afferent and efferent arterioles are innervated by sympathetic nerves that act via $\alpha 1$ receptors to cause vasoconstriction.

However, since far more $\alpha 1$ receptors are present on **Afferent arterioles**, increased sympathetic stimulation will cause a decrease in both RBF & GFR.

- **ANGIOTENSIN II:**

This is a potent vasoconstrictor. However **Efferent** arteriole is more sensitive to Angiotensin II. Hence low levels of Angiotensin II causes increase in GFR while high levels of Angiotensin II will decrease GFR. RBF is decreased.

- **PROSTAGLANDINS:**

PGE₂, PGI₂ are produced locally in the kidneys – cause vasodilation of both afferent & efferent arterioles.

This effect is protective for renal blood flow, it modulates the vasoconstriction produced by sympathetic & angiotensin-II

- **DOPAMINE:**

At low levels Dopamine dilates Cerebral, Cardiac, Splanchnic & Renal arterioles and constricts Skeletal Muscle and Cutaneous arterioles.

Hence low dose Dopamine can be used in the treatment of hemorrhage.

- **AUTOREGULATION OF RENAL BLOOD FLOW:**

Myogenic theory

Tubuloglomerular feedback by Juxta Glomerular Apparatus (JGA).

- **Assessing Kidney Function:**
Albumin excretion (microalbuminuria)
Plasma concentration of waste products
(e.g., creatinine)
Clearance methods (e.g. 24-hr creatinine clearance)
Imaging methods (e.g. MRI, PET, arteriograms, ultrasound)

- **Renal clearance** of a substance is the volume of plasma completely cleared of a substance per min by the kidneys.

For a substance that is freely filtered, but not reabsorbed or secreted (inulin, , creatinine), renal clearance is equal to GFR.

- Creatinine clearance is used as a rough estimate of GFR
- Normal plasma serum creatinine level is 1mg/100ml.
- Use of PAH Clearance to Estimate Renal Plasma Flow
- Effect of reducing GFR by 50 % on serum creatinine concentration and creatinine excretion rate :
↓ GFR by half*50%) will double the toxic level in plasma)

- Clearances of Different Substances

Substance	Clearance (ml/min)
inulin	125
PAH	600
glucose	0
sodium	0.9
urea	70
creatinine	140

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- The kidney can excrete **dilute** urine with an **osmolarity** as low as **30 - 50mosm/liter**.
- **Concentrated** urine with osmolarity as high as about **1200 -1400mosm/liter**.
- **urine volume** between 0.5-20 L/day
- **Urine Concentration, basic requirements for forming a concentrated (or diluted) urine is:**

1. **Secretion of antidiuretic hormone (ADH):**

Water reabsorption from the collecting ducts depends on:

The **blood level of Antidiuretic Hormone (ADH)**: Regulates the permeability of the distal tubules and collecting ducts to water.

High ADH causes high reabsorption of water → Concentrated Urine.

2. **The Medullary interstitium (MI) hypertonicity :**

Provides the osmotic gradient necessary for water reabsorption to occur in the presence of high level of ADH. ,cus it has long lobe of Henle that will increase the reabsorption

- **Counter Current Mechanism:**

Is a function of Juxta-medullary nephrons.

Consists of ...

- 1- Counter Current **Multiplier** system**

Creates the high osmolarity of the renal medullary interstitial fluid: **by loop of henle**

- BENEFITS: * functions***

- I. It establishes a vertical osmotic gradient in the medullary interstitial fluid. This gradient, in turn, is used by the collecting ducts to concentrate urine more than normal body fluids can be excreted.
 - II. Second, the fluid is hypotonic as it enters the distal parts of the tubule enables the kidneys to excrete a urine more dilute than normal body fluids.

- 2- Counter Current **Exchanger** system**

Maintains the high osmolarity of the renal medullary interstitial fluid : **by vasa recta**

- NaCl : create horizontal osmotic gradient= 200mOsm*
- When ADH is secreted in blood, it increases the permeability of the tubule cells to water by increasing the Aquaporin-2 water channel proteins.
- **Syndrome of Inappropriate Antidiuretic Hormone secretion or **SIADH****

is characterized by excessive release of antidiuretic hormone resulting in water retention and dilutional hyponatremia.(**concentrated urine**)
- **Diabetes Insipidus *DI***
is a condition characterized by excessive thirst and excretion of large amounts of severely diluted urine due to either a problem with the production of ADH (Central D.I) or decreased kidney's response to ADH (Nephrogenic D.I). (**dilutional urine**)